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Abstract

We examined the change in Swiss suicide rates since 1969, breaking down the rates according to the method used. The descriptive analyses of the main suicide methods are presented. The suicide rates reached a peak in the late 1970s / early 1980s and declined in more recent years. Firearm suicides and suicides by falls were the exception and sustained their upwards trend until the 1990s. Suicide by vehicle exhaust asphyxiation showed a rapid decline following the introduction of catalytic converters in motor vehicles. No substantial method substitution was observed. Suicide by poisoning declined in the 1990s but rose again following an increase in assisted suicide in somatically incurable patients.

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Key words: suicide, prevention, firearms, asphyxia, vehicle emissions, poisoning, antidepressive agents, legislation

1. Introduction

Over the past two decades suicide rates in Switzerland have declined as in other European countries. [1]., After a decade of increasing suicide rates the overall suicide rate peaked in the late 1970s and early 1980s at about 25 per 100'000 and fell to about 17 per 100'000 by the late 1990s. The reasons for this decline still remain vague.

Improvement in the treatment of psychiatric conditions, first and foremost depression, has been the most frequently cited explanation for the decline in suicide rates. Examination of the background shows that in up to 90% of all suicides a psychiatric disorder existed at the time of suicide, most prominently affective disorders [2-5]. Most psychiatric disorders are associated with a heightened risk of suicide [6].

International studies using a pharmaco-epidemiological approach have provided evidence that the increased prescription of antidepressant medication, especially selective serotonin reuptake inhibitors (SSRI), may have contributed to a decline in suicide [7-14]. Better recognition and treatment of depression are important preventive strategies [15-17]

The restriction of the availability of lethal methods is another widely discussed approach to suicide prevention. The detoxification of domestic gas [18], legislation and regulatory measures reducing the availability of firearms [19-22] and the introduction of catalytic converters (albeit introduced for environmental reasons, reducing suicide by vehicle exhaust asphyxiation) [23-26] are examples of restricting the availability of lethal methods. In the 1980s and 1990s the introduction in Switzerland of catalytic converters and the launch of SSRI that replaced the more toxic tricyclic antidepressants

were measures which influenced the availability of suicide methods. The effects of restricting the availability of methods might be reduced by method substitution [27]. Understanding the dynamics over time of different methods of suicide is crucial.

The aim of this study was to analyse changes in Swiss suicide rates from 1969 until 2005 with particular regard to different suicide methods.

2. Data and Methods

Suicide data was extracted from the Swiss cause-of-death statistics courtesy of the Federal Statistical Office in Neuchatel. The data entered in the analyses cover the period 1969-2005. ICD-8 coding was in use 1969-1994, and ICD-10 coding since 1995. Since 1998, an extra code ("X618") declares assisted suicides allowing the differentiation of this cause of death in the analyses.

The registration rules commonly assign the highest registration priority to violent causes of death which results in suicide being registered as the main cause of death. As a violent cause of death, suicides are subject to routine investigation by the police and legal medicine; an autopsy is not performed on all suicides. Autopsy rates may give some information on the quality of the official mortality statistics and may have some influence on the suicide rates [28]. Information on autopsies has been included in the Swiss cause-of-death statistics since 1995. The overall proportion in suicides is 25.4% in males and 27.6% in females. There is no obvious trend since 1995. Regarding the method of suicide, the proportion of autopsies is lowest in violent methods such as railway suicides (17.4%) and in hanging (22.4%). Proportions between 35%-40% may be found in drowning, cutting and the category "other suicides".

In the descriptive analyses, the suicide rates were differentiated by sex and the method of suicide. We calculated 3-year moving averages to smooth the series and to provide better insights into any trends.

3. Results

In the thirty-six year period between1969-2005 the Swiss mortality statistics included 52'385 suicides: 36'868 (70.4%) men and 15'517 (29.6%) women.

Table 1 shows the aggregate frequencies by sex and suicide method. Hanging and firearms are the most frequent methods in men and together account for approximately 60% of all suicides in males. Poisoning is the most frequent suicide method for women and accounts for every fourth suicide. Hanging, drowning and falls have proportions between 15% and 20%; whereas firearms and other methods play a marginal role. A glance at the sex-ratios shows that exhaust fumes and firearms are undoubtedly "male methods" whereas the sex-ratio is more balanced in poisoning and drowning.

(Table 1)

Longitudinal figures show a peak around the year 1980 and a decline of suicide rates in the 1980s and 1990s. Similar overall patterns occur for both men and women (Figure 1). However, dissimilarities are apparent in specific longitudinal patterns (Figures 2a-b). Firearm suicides and falls (in males) show an extended increase of rates until the 1990s. In fact, firearm suicides have surpassed hanging which was traditionally the most frequent method in male suicides. Vehicle exhaust asphyxiation, also a predominantly male method, shows a delayed but marked decline compared to the overall suicide rate. Suicide rates by poisoning in females, and less obvious in males, follow the overall suicide rate until the 1990s, when a remarkable increase can be observed. This is due solely to assisted suicides reaching 140 registered cases in 2005 (64 males and 76 females). If we extract these figures, poisoning suicides show the same downward trend.

(Figure 1)

(Figures 2a-b)

4. Discussion

The overall suicide rate

The Swiss suicide rate reached a peak around 1980 and declined in the following two decades. This corresponds to the the European Union (EU)'s suicide rates that peaked at 16 per 100'000 in the early 1980s and declined to 14 per 100'000 in the late 1990s. Whereas in the EU and in the United States mainly female suicide rates declined, Swiss suicide rates declined for both sexes in parallel [1]. This downward trend was apparently halted in the last few years. This is mainly due to the growing number of assisted suicides which are supported by non-profit organisations and are permitted by the liberal Swiss legislation relating to assisted suicide in somatically incurable patients. The decline in the suicide rates appears even more accentuated (Figure 1) when the the data for assisted suicides (corresponding to a rate of about 1.5 per 100'000) is excluded.

In Switzerland, as in other countries, the use of SSRI in the treatment of depression has probably increased over the years since their introduction. SSRI have fewer adverse effects and are less toxic when overdosed than the older tricyclic antidepressants and therefore are easier to handle for general practitioners [29]. There are several studies that could show an inverse correlation between prescription of SSRIs and suicide rates [7-14]. However, in some countries an increase of antidepressant prescriptions did not or only partially correlate with suicide rates [30, 31].

The increase in prescription of antidepressant medication is accompanied by a better recognition of depressive conditions and an improvement in comprehensive treatment of depression by primary care professionals [7, 8]. In the past two decades in Switzerland efforts have been made to train

general practitioners in the recognition and treatment of depressive and suicidal persons [32]. Access to psychiatric and/or psychotherapeutic treatment has been improved and the costs are covered by health insurance. Furthermore, there have been efforts made to destigmatize mental disorders, making it easier for depressive and suicidal persons and their families to seek professional help. Basically, the increase in prescription rates of antidepressants is not feasible without an increase in the number of people seeking help from (mental) health professionals. Unfortunately, there is no longitudinal data available on prescription rates and health care utilisation in Switzerland.

However, focussing exclusively on depression abstracts away from the fact that any psychiatric disorder might go along with an increased risk of suicide [6] and it is noteworthy that any effort to improve recognition and treatment of mental disorders will not reach all suicidal persons [16]. Therefore a differentiated view to various lethal methods is important.

Suicide methods

The overall Swiss suicide rates, as well as the rates in most methods (poisoning, hanging, drowning, and cutting), show a downward trend which is compatible with trends in other Western countries [1]. However, the descriptive analyses show quite clearly that the trends did not proceed uniformly in all methods. Methods such as suicide by firearms, falls, poisoning and vehicle exhaust asphyxiation, i.e. methods that either stand out in international comparison or that diverge from overall trends in suicide rates, deserve special attention.

Firearm suicides are the predominant method of suicide in men in Switzerland. Unlike other suicide methods, firearm suicides did not follow the downward trend of the overall suicide rate and showed

only a moderate decrease with a delay. Since 35% of all households in Switzerland hold firearms [19, 33], their widespread availability can be assumed to be the main reason for the high rate of firearm suicides in Switzerland. The household ownership of firearms is recognized as a major risk factor for firearm suicide [20, 21]. Restriction of the availability of firearms has been shown to reduce firearm suicide [19, 34]. Suicide by firearms is one of the most lethal methods: if there is access to a gun it needs hardly any preparation and it is therefore often used in impulsive suicide acts [35]. As the Gotland study shows, the intervention had no influence on violent male suicides, most of the victims being unknown to the medical system [16]. Possibly, suicides by firearms are less affected by the improvement of treatment facilities for mental disorders. Either these individuals do not enter the medical system or, if they do, their suicidal state is not recognized [36-38]. In fact, attempted suicide by firearms is associated with a diagnosis of adjustment disorder (axis I) and antisocial and borderline personality disorder (axis II) [39] and is less likely to be associated with a history of psychiatric treatment [39, 40].

Suicide by falls compared to the overall suicide trend also has a less marked decrease over time. Falls attract the attention of two specific groups of suicidal persons and are, in some way, the complementary suicide method to firearm suicides. The proportion of former psychiatric patients is highest in persons with fall suicides, and it is lowest in persons committing firearm suicides [40]. In addition, falls are disproportionately frequent in inpatients' suicides [39, 41, 42]. Patients with severe mental disorders who were receiving treatment or who had recently been treated presumably profit least of all from this increasing treatment of depression. The second diverging group in fall suicides is associated with so called "hot spots" and comprise suicides triggered by imitation effects. This group is similar to firearm suicides in so far as impulsive actions predominate. It could be

argued that there was a partial method substitution from suicides by vehicle exhaust asphyxiation to hanging and firearm suicides: aggressive methods predominantly chosen by males.

In the 1980s a decline was observed in suicide by poisoning. This followed the general trend. The availability of potentially lethal drugs such as paracetamol was restricted in the past decades, and the wide-spread use of the less toxic SSRIs in place of tricyclic antidepressants may have fostered this trend. From the 1990s on there was a remarkable increase, mainly in females, which can be attributed to an increase in assisted suicide in somatically incurable patients. This is an example where not only the availability, but also the acceptance of certain suicide methods, plays an important role. A new phenomenon has arisen in Switzerland: “suicide tourism”. People from European countries with restrictive legislation on assisted suicide travel to take advantage of the more liberal Swiss laws. (However, these suicides are not covered by the Swiss cause-of-death statistics).

The steepest decline in the rates was found in suicides by vehicle exhaust asphyxiation after the mid 1980s. In 1986 the legislation for catalytic converters for motor vehicles was introduced in Switzerland, requiring maximum carbon monoxide (CO) levels of 0.5g/km. The estimated annual rate of replacement of vehicles is about 10%. In 1995 there were approximately 6% and now there are approximately 2% of registered motor vehicles without catalytic converters (Federal Bureau of Environment, personal communication). In Australia, no reduction in exhaust gas suicides was observed, but the limits for CO emissions were 9.3g/km from 1986 on. In 1997 the limits for CO emissions were reduced to 2.1g/km. Hospitalizations after attempted suicide have doubled, suggesting an increase in failed attempts and the rate of exhaust gas suicide is flattening in the 1990s [25]. A fall in deaths from car exhaust gas was observed in England and Wales after the introduction

of catalytic converters in 1993. There was also a decline in the overall suicide rate. However, in 15-44 year-olds there was no decline in the overall suicide rate. In this age group there was an increase of suicides by hanging which can be interpreted as a partial method substitution [23, 26]. Suicide by vehicle exhaust asphyxiation is a violent method predominantly used by males. Some of the above considerations about firearm suicides may also apply to vehicle exhaust asphyxiation. Although an increase in the rate of hanging could not be observed in Switzerland, it is possible, that some of the effect of the introduction of catalytic converters was reduced by method substitution with firearms and falls. It is likely, but impossible to prove, that in Switzerland the legislation with low limits for CO emissions led to an overall reduction in suicide rates that was not fully compensated by other methods. Another widely discussed natural quasi-experiment potentially affecting the suicide rates was the reduction in the availability of toxic domestic gas. Around 1960, for example, almost half of all suicides in the UK were committed by domestic gas. After the detoxification of domestic gas, there was a decline of domestic gas suicide from 6 per 100'000 in males and 4 per 100'000 in females to near zero. Within the same 15 years period the overall suicide rate declined from 14 to 10 per 100'000 in males and from 9 to 6 per 100'000 in females, which indicates that there was only a partial substitution of methods [18, 26]. In Switzerland, the detoxification of domestic gas in the 1950s and 1960s was associated with a decline in the overall suicide rate and no marked method substitution was observed [43].

The restriction of the availability of means is an important component of comprehensive suicide prevention. The detoxification of domestic gas, the introduction of catalytic converters for motor vehicles, the restrictions on the availability of firearms, potentially lethal drugs and toxic substances and the protection of so-called "hot spots" by anti-suicide fences [44] are strategies to reduce access to lethal means. For some suicide methods such as hanging and drowning the availability and access

can hardly be influenced. The continuous decline of suicides by drowning from the 1970s might be due to a greater effort to teach swimming in schools (as a prevention of accidental drowning) and a declining proportion of non-swimmers. There is evidence that individuals have a preference for specific methods and will not shift easily to another method [27]. Given that suicidal crises are often time-limited, and the time between the decision and the suicidal act is often very short [45] a restricted access to a certain method might be sufficient to avoid a suicide [27]. The restriction of means has an impact on method-specific suicide rates and there is evidence that this results in a reduction of overall suicide rates [46]. Therefore, it is important to evaluate method-specific and overall suicide rates with regard to changes in the availability of means.

Limitations

This study is a descriptive study and we did not correlate overall suicide rates and rates for separate methods with changes in actual consumption of antidepressant medication, health care utilisation, socioeconomic factors and risk factors such as alcohol consumption.

Suicide frequencies derived from mortality statistics generally underestimate to a certain extent the real number of suicide deaths. Potential mis-reporting typically falls into categories such as "injuries undetermined whether accidentally or purposely inflicted", “injuries due to drowning”, “injuries due to vehicle crashes” and “poisonings”. In general, changes between registration patterns in the cause-of-death statistics may be assumed to progress slowly and to modify long term trends, for example from the 19th towards the 20th century. For the analysis of change reported below they cannot be expected to contribute noteworthy information.

5. Conclusions

The overall suicide rate in Switzerland is comparable with trends in the European Union. Analysing changes of suicide rates for different methods separately revealed some interesting insights. Suicide is too often regarded as a homogeneous phenomenon. However, suicide victims are a heterogeneous population with regard to methods of suicide, psychiatric diagnoses, age, sex and socioeconomic background. It is evident that different suicide methods are chosen by different people and that differentiated preventive strategies are needed. The decline of suicide rates in Switzerland is compatible with the hypothesis focussing on the increase in recent decades in the prescription of antidepressant medication. There is a coincidence in the introduction of SSRIs (a new class of antidpressants), an increased awareness in health professionals of depression and suicide and, finally, a growing social acceptance in the population of seeking help for mental problems. Nevertheless, there is enormous potential left for improving the range of professional help in this domain. Preventive strategies are also required to contain suicides with an impulsive background. This implies the restriction of the availability of means, primarily firearms, as firearm suicides are often highly impulsive and not planned ahead [35, 45]. Legislation and measures reducing the availability of weapons would be the appropriate means to counter this problem [19-22]. The introduction of catalytic converters in 1986 – although not primarily implemented as a suicide prevention measure – demonstrated that reduction in availability has an impact on suicide by a specific method [23-26].

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Figure 1: Suicide rates in Switzerland, 1969-2005, by sex; the series are smoothed by a 3 year moving average (The lower curves correspond to suicide rates without assisted suicides)

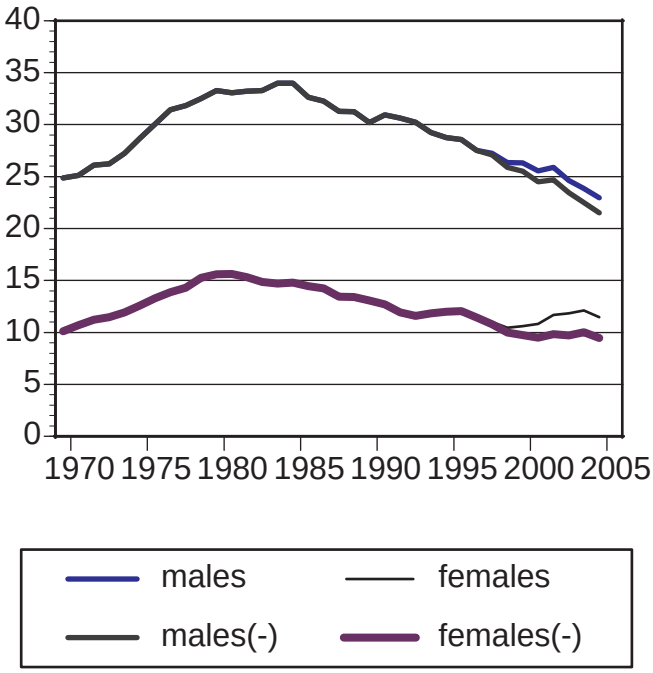

Figure 2a: Method specific suicide rates in Switzerland, 1969-2005, by sex; the series are smoothed by a 3 year moving average (poisoning, exhaust fumes, hanging, drowning). Poisoning: the dashed curves corresponds to rates of suicide by poisoning without assisted suicides

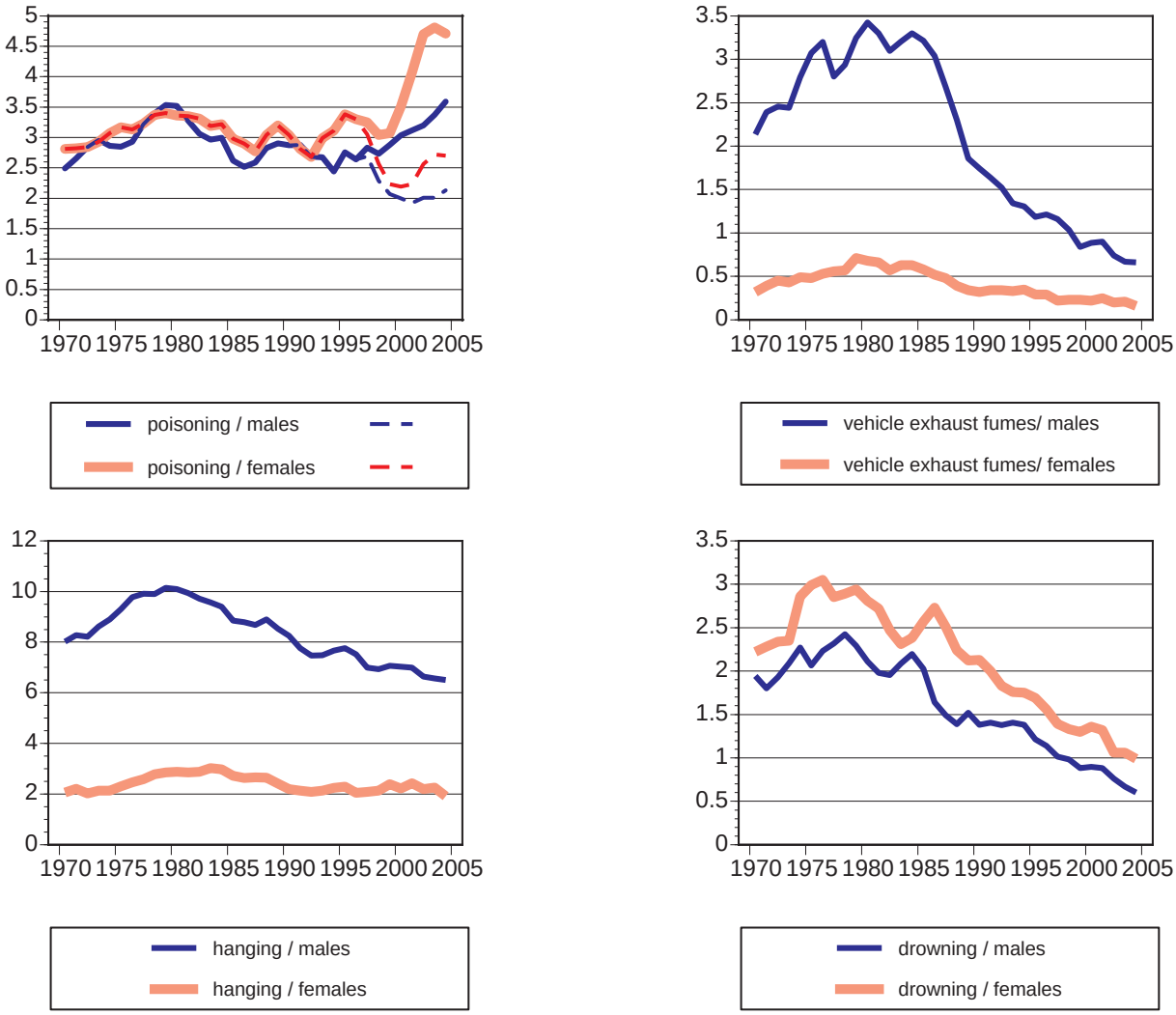

Figure 2b: Method specific suicide rates in Switzerland, 1969-2005, by sex; the series are smoothed by a 3 year moving average (firearms, falls, railway)

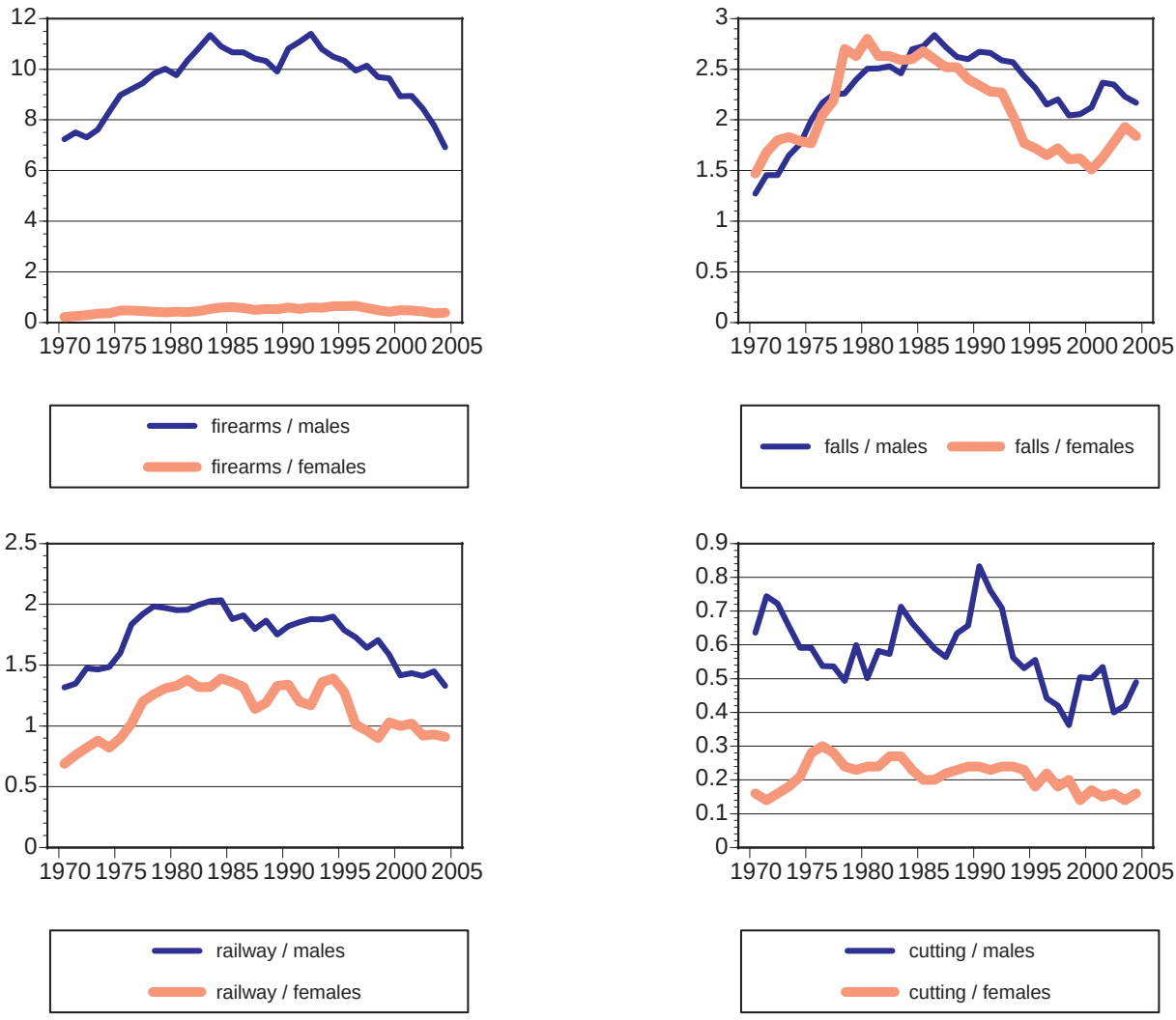

Table 1: Frequencies of suicides in Switzerland, 1969-2005, by suicide method and sex

suicide method	ICD-8 code	ICD-10 code	frequency	percentage	frequency by gender (m / f)	percentage by gender (m / f)
poisoning by solid or liquid substances	950	X60-X669	7819	14.9		
					3696	47.3
					4123	52.7
poisoning by other gases	952	X67-X699	3003	5.7		
					2512	83.7
					491	16.3
hanging, strangulation	953	X70-X709	13284	25.4		
					10324	77.7
					2960	22.3
drowning	954	X71-X719	4511	8.6		
					1937	42.9
					2574	57.1
firearms, explosives	955	X72-X759	12442	23.7		
					11852	95.3
					590	4.7
cutting, piercing	956	X78-X799	982	1.9		
					722	73.5
					260	26.5
jumping from high places	957	X80-X809	5427	10.4		
					2842	52.4
					2585	47.6
run over by a train	958.00	X818	3503	6.7		
					2128	60.8
					1375	39.2
other	951, 958 (ex 00), 959	other	1414	2.7		
					855	60.5
					559	39.5
total	950-959		52385	100.0		
					36838	70.4
					15517	29.6